REVIEW AND CURRENT STATUS OF IMAGE GUIDED INTERVENTIONAL TECHNIQUES IN THE MANAGEMENT OF CHRONIC LOW BACK PAIN

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Abstract: *Chronic low backache (LBA) is a ubiquitous malady affecting almost 60-80% of the adult population sometime in their lives and leading to considerable loss of working man-hours and productivity. It is a multifactorial disorder with many possible etiologies and due to the complex structure of the spine, it is often difficult to pinpoint the exact structure causing symptoms. Percutaneous injection techniques have been used to treat back pain for many years but with conflicting and controversial results. An increasing number of patients with lumbo-sacral and sacroiliac pain can be evaluated and treated with interventional procedures including injections of local anesthetics or long-acting steroids into facet joints, sacroiliac joints, selective nerve roots, spondylolytic areas, and the epidural space. Most of these techniques are simple, safe, cost effective and useful in the short and medium term. In recent years there has been an increasing realization by surgeons that not all patients with LBA respond to surgery. In cases with failed back surgery syndrome (FBSS) where outcomes with repeat surgeries are poor and response to conservative management disappointing, Interventional techniques offer a viable alternative treatment option.*

Key Words: Chronic back pain, Interventional technique, Facet joint, Epidural steroid, Epidural adhesionolysis

INTRODUCTION

Low back pain is the most frequent cause of activity limitation in people below the age of 45 years, the fifth most frequent cause for hospitalization, and the third ranking for surgical procedures[1]. Lifetime prevalence of spinal pain has been reported as 65% to 80% [2]. Chronic pain may be variously described as - pain which persists a month beyond the usual course of an acute disease; persistent pain that is not amenable to routine pain control methods; pain that exists beyond an expected time frame for healing and pain where healing may never occur[3].

Interventional techniques in the management of chronic spinal pain in-clude neural blockade and minimally in-vasive surgical procedures ranging from epidural injections, facet joint injections, and neuroablation techniques, to intra-discal thermal therapy, disc decompres-sion, morphine pump implantation, and spinal cord stimulation[4]. Anatomical structures incriminated as possible sources of chronic LBA, includes facet joints, discs, nerve roots and the sacro-iliac joints. Contrary to the commonly held belief, disc herniation contributes to only a small fraction of these. In large studies employing precision diagnostic injections to locate the cause of low back pain, the source of pain was facet joint(s) in as many as 24-40%, disc herniation and nerve root irritation in 13-20%, discogenic pain in 26% and sacroiliac joint pain in 4-6%. In 13-19% patients the cause of pain still remained elusive[3]. In cases of Post laminectomy pain syndrome or Failed Back Surgery syndrome (FBSS), the non-surgical causes outnumber the surgical causes with facetal arthropathy noted in as many as 32% and epidural fibrosis in 45% of cases[5].

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PATIENT WORK UP AND SELECTION

The patient should be symptomatic with chronic backache and disability of moderate to-severe degree for at least three months duration that was unresponsive to conservative treatment, including the administration of nonsteroidal anti-inflammatory drugs and rest followed by physical therapy and physiotherapy. It is essential to exclude other causes such as disc herniation, spinal stenosis and nerve entrapment. The procedure is explained to the patient in detail and written consent obtained. Contraindications include allergy to local anaesthetics or steroid, bacteri-al infection, possible pregnancy, bleeding diathesis, and anticoagulant therapy. Pre-cautions are warranted in patients with anti-platelet or anticoagulant therapy and dia-betes mellitus[6].

FACET JOINT INTERVENTIONS

Facet joints are true synovial joints, with a joint space, hyaline cartilage surfaces, a synovial membrane, and a fibrous capsule. Two medial branches of the dorsal rami innervate the facet joints. In recent studies, nociceptive substance P immunoreactive nerve fibers and autonomic nerves have been identified in the lumbar facet joint capsule and synovial folds, which may cause pain under increased or abnormal loads. This may be a consequence of segmental instability, inflammatory synovitis, degenerative arthritis or a combination of these[6].

The features most commonly associated with the syndrome are enumerated in Table 1.

Table 1 : *Features of Facet Syndrome*

Clinical Features of Facet Syndrome
1. Backache and tenderness localized over one or more facet joints
2. Diffuse referred pain over the buttock and sometimes posterolateral thigh
3. Exacerbation of pain with any sustained posture
4. Loss of lumbar lordosis, or paraspinous muscle spasm
5. Exacerbation of pain with hyperextension.

A diagnosis of facet syndrome relies exclusively on the results of radiographically confirmed diagnostic anesthetic blocks [6]. Based on responses to controlled diagnostic blocks of these joints, facet joints have been implicated as responsible for spinal pain in as many as 15 % to 45 % of patients with low back pain[3]. Ghormley described facet joint mediated pain as early as in 1933 and also described the facet syndrome [7]. Since facet joint mediated pain is one of the commonest etiologies of chronic LBA, many techniques have been developed to diagnose and treat it. Described below are the most commonly practiced of these-namely, facet joint injections, facet denervations and injections for spondylolysis.

FACET JOINT INJECTIONS

Facet joint injection with local anesthetic and steroid is the simplest and most common procedure for facet joint mediated pain. These infiltrations are diagnostic as well as therapeutic and performed under CT or fluoroscopic guidance. Levels for injection are selected on the basis of local pain or tenderness and imaging evidence of disease, and occasionally upto three levels injected. Once the facet joint appears in profile as two parallel lines on fluoroscopy, with least obliquity, this point is marked on the skin. After cleaning and draping and local anesthesia, a 22 G spinal needle is inserted in line with the X-ray beam till it contacts bone at the lip of the facet joint. With fine movements the needle tip pops into the joint with a distinct 'give' [Fig 1]. Once the needle is in place, 1 – 1.5 ml of a mixture of 20 mg of Depomedrol and 0.25% bupivacaine is injected into each joint. The lumbar facet joint typically has a volume of 0.8 to 1.2 ml and care is taken not to inject a larger volume. CT guidance is useful in patients with large osteophytes that block access to the joint or in whom the fluoroscopic procedure fails particularly at the more oblique L5 – S1 joint (Fig.2). More recent trials have documented encouraging reports of short term and limited evidence of long-term (3–6 months) pain relief [8].

FACET DENERVATION

Denervation of the facet joint for facetal pain is achieved by denervation of the medial branch of the dorsal ramus by 95% ethanol or radio frequency (RF) ablation. Since the facet

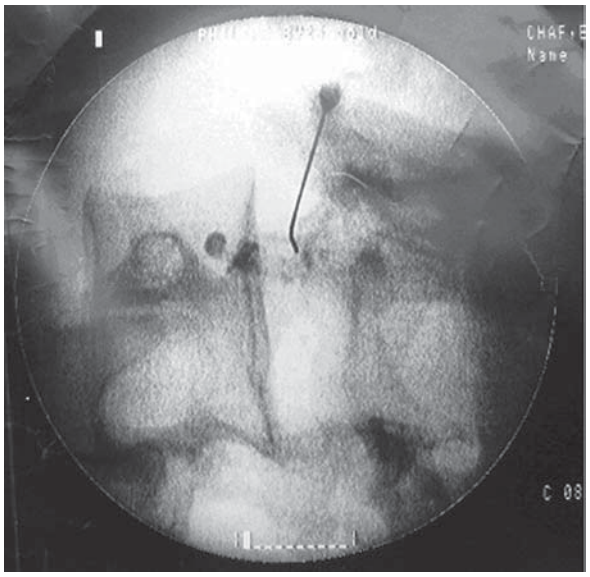

Fig 1: *Fluoroscopic guided facet joint injection with intra articular position of needle*

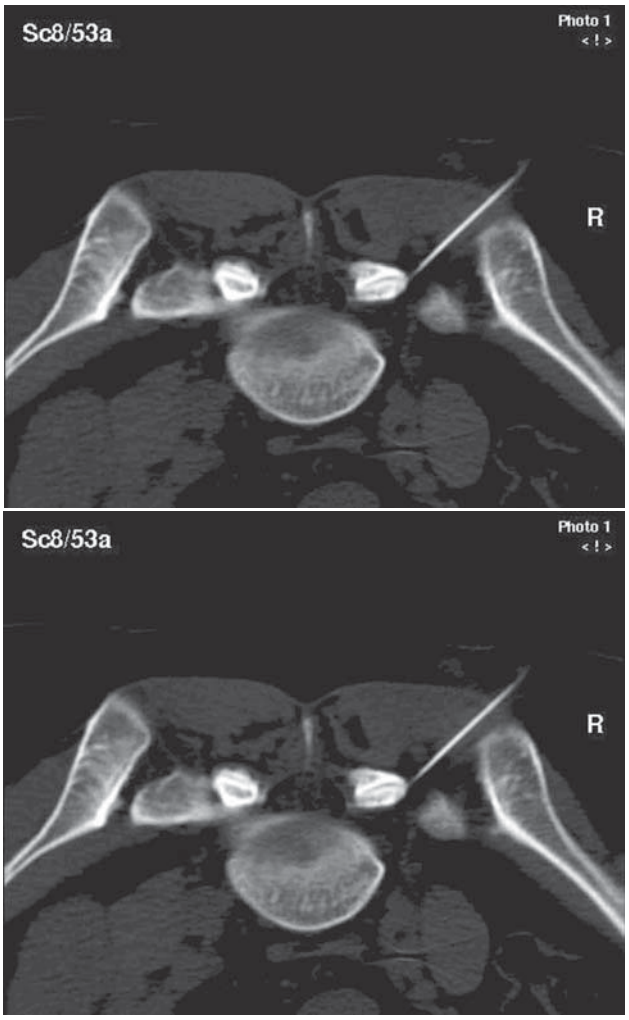

Fig 2: CT guided facet injection demonstrating needle positioned in right L5-S1 facet joint.

joint is supplied by medial branch nerve exiting at the level of the facet joint as well as at the next higher level, denervating a facet joint requires to be done at two levels [8]. The procedure may be performed with CT or fluoroscopic guidance. The patient is prepared and positioned in a similar manner as for facet injections. A 22–gauge spinal needle or RF needle is advanced in a gun barrel fashion towards the transverse processes (eye of the "Scottie dog") above and below the target facet joint(Fig.3). Once the position is confirmed, 1 ml of nonionic contrast material is injected followed by injection of 1.5 ml of 95% ethanol at each level. [9]. The proponents of ethanol and RF ablation have demonstrated similar results – excellent pain relief in the immediate period and moderate (50-60%) relief in the long term[10]. Choice of the modality will largely depend on availability and preference of the operator. According to the current guidelines formulated by Boswell et al, the evidence for facet denervation by medial branch neurotomy is moderate to strong for short-term and long-term relief of lumbar facet joint pain[11].

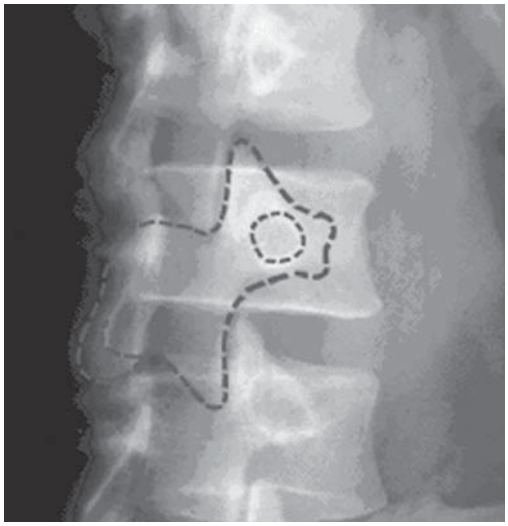

Fig 3: *"Scottie Dog appearance" on Oblique radiograph with the facet joint seen behind the ear and the eye shows the area where the medial branch nerve is targeted.*

INJECTION FOR SPONDYLOLYSIS

Image guided infiltration at the level of spondylolysis is carried out for otherwise unexplained local pain at that level, either at fracture site at pars inter-articularis break or at adjacent facet joint. CT guidance is preferred because the pars defects are easily identified at CT [Fig 4]. The procedure is similar to a CT-guided facet joint injection and using a 22-gauge spinal needle a combination of a local anesthetic and steroid - 1 ml of Bupivacaine 0.25 % and 20 mg of Depomedrol are injected on each side. Complications due to facet joint infiltrations or denervation are related to needle placement and drug administration. These include dural puncture, spinal cord trauma, infection, intravascular in-jection, spinal anesthesia, chemical men-ingitis, neural trauma and hematoma formation. Facet capsule rupture may occur if large volumes of injectate are used for intraarticular in-jections.

Fig 4 : *CT guided infiltration of right L5-S1 spondylolytic site*

EPIDURAL STEROID INJECTIONS

Epidural injection of corticosteroids is one of the most commonly used interven-tions in managing chronic spinal pain and anesthesiologists have for long performed blind epidural injections. Fluoroscopic guidance aids the diagnosis and confirms spread as prior epidurography is performed with non-ionic contrast media. Epidural steroids have been widely used for a number of indications ranging from local pain or radiculopathy in the setting of documented disk herniation, central or foraminal stenosis, and in FBSS with epidural adhesions. Various combinations of saline solution, local anesthetics, and steroids have been injected and relief of pain is variously attributed to lysis of adhesions, change in relationship between the disk and the nerve root and reduction of inflammation and swelling.

CAUDAL EPIDURAL INJECTIONS

Fluoroscopic guided caudal epidural entry is relatively easily achieved with minimal risk of inadvertent dural puncture. Keeping the needle below the S 2-3 disk space minimizes the risk of dural puncture and it is helpful to keep the needle as horizontal as possible. An epidurogram is performed by at this stage by injecting 8 - 10 ml of non-ionic contrast (Onmipaque) diluted to 50 %. Postero-anterior fluoroscopy is performed at this stage to outline epidural anatomy of nerve roots, fat and adhesions [Fig 5]. Disadvantages of the caudal ap-proach include: requirement of substan-tial volume of fluid, dilution of the injec-tate, extra-epidural placement of the nee-dle, and increased risk for intravascular placement of the needle. Large randomized trials have concluded that their effectiveness in managing lumbar radiculopathy is strong for short-term relief and moderate for long term relief. The evidence in post lumbar laminectomy syndrome was

however limited[11,5].

INTERLAMINAR EPIDURAL INJECTIONS

This is a refinement of the epidural approach where the entry is more close to the assumed site of pathology. This method requires less volume than the caudal route and therefore can be used in cases where one or two segments are involved (Fig 6). For a dorsal interlaminar approach, the patient is placed in the prone position with a pillow under the abdomen. An antero-posterior view is obtained fluoroscopically and an 18-gauge epidural needle with an air filled syringe attached is advanced to the posterior margin of the spinal canal. Epidurography is performed with 8 - 10 ml of nonionic myelography approved iodinated contrast material followed by 80 mg of Depomedrol and 10 -15 ml of saline. There are various pitfalls with the interlaminar approach and this technique is not as operator friendly as a caudal epidural. Dilution of the injectate, preferential cranial and posterior flow of the solution, extra-epidural and intravascular place-ment of needle, dural puncture and trauma to spinal cord are few of them[13].

***Fig 5 (a)**: Normal Epidurography showing X-mas tree appearance.*

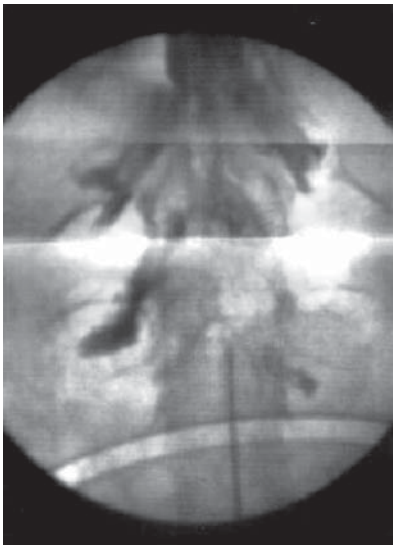

***Fig 5 (b)**: Epidurography showing epidural fibrosis on the left. Note needle through sacral hiatus*

TRANSFORAMINAL EPIDURAL INJECTIONS / SELECTIVE NERVE ROOT BLOCKS

Ttrans-foraminal approach is target specific and aims at reaching the primary site of pathology with smallest volume - ventrolateral epidural space around the dorsal nerve roots. The aim of selective nerve root blocks (SNRB) technique is to attempt to anesthetize the desired nerve for diagnostic as well as therapeutic purposes. Selective nerve root blocks are used primarily in the following subsets of patients with radiculopathy:

a) In post discectomy patients with recurrent radiculopathy but no recurrent disk herniation.
b) Patients with disk herniations not willing for surgery.
c) Nerve root blocks can help patients with symptoms related to a nerve root but who have no definite radiologic diagnosis explaining the symptoms.
d) In patients with uncertain pain etiology, SNRB is an effective and accurate means of determining if a certain nerve root is the source of the symptoms.

A 22-gauge spinal needle is advanced under the pedicle with the patient in position. Bending the distal 5 mm of the needle by $10 – 15^{0}$ aids in positioning into the neural foramen (Fig 7). 1 % Lignocaine (for a diagnostic block) or 1 - 2 ml of an appropriate steroid mixed with a small amount (0.5 ml) of

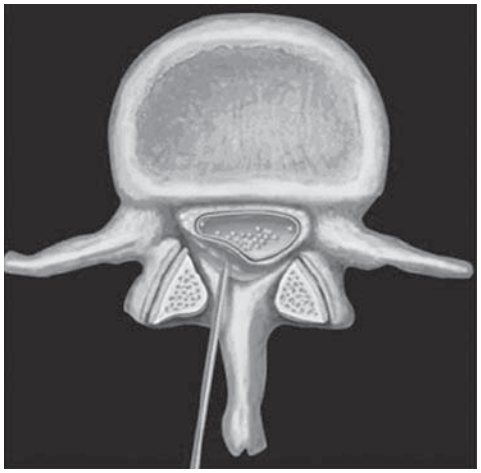

***Fig 6:** Diagrammatic representation of trans-laminar epidural injection. (Image source- www.amirsys.com/tour_pr/PR_Interventional_Sample.pdf accessed on 15/5/06)*

bupivacaine (for a therapeutic block) is then slowly injected. A number of trials have demonstrated the efficacy of selective nerve root blocks with most studies reporting an average time of pain relief as 1-3 months. Maximum benefit was found in patients with foraminal stenosis, as compared with those who had disk herniations. Complications due to epidural injections are rare and include dural puncture, infection, hematoma formation, abscess formation, subdural injection, intracranial air injection, epidural lipomatosis, nerve damage, headache, intravascular injection, cerebral vascular or pulmonary embolus and effects of steroids. Spinal cord trauma and spinal cord or epidural hematoma formation and cord infarction are potentially catastrophic complications [12,13,14].

EPIDURAL ADHESIONOLYSIS

Percutaneous epidural adhesionolysis is a refinement of the epidural technique, which allows a targeted delivery of steroids and hyaluronidase in an attempt to lyse epidural adhesions and fibrosis - which are the commonest cause of FBSS. Because scar formation is often uneven, multiple passes are often required to access the scarred areas. Targeted installation of hyaluronidase and steroids in 20-30 ml of saline are instilled to achieve volumetric adhesionolysis. All the prospective studies done so far to evaluate the effectiveness of spinal endoscopic adhesionolysis in lumbar spinal stenosis have reported good short-term and long-term improvement in low back pain but with limited success with leg pain[4,15]. Complications with adhesionolysis are catheter shearing, dural puncture and hematoma. High volumes of fluid may lead to excessive epidural hydrostatic pressures. This may cause spinal cord compression, excessive intraspinal and intracranial pressures[14].

SACROILIAC JOINT INTERVENTIONS

The sacroiliac joint is a diarthrodial joint with a joint capsule and synovial fluid. The sacral side of the joint is lined with the hyaline cartilage and the iliac side with fibrocartilage and receives innervation from the lumbosacral nerve roots. Common causes of SI joint pain are seronegative spondyloarthopathies and mechanical causes due to prolonged loading or leg asymmetry. On the basis of precision diagnostic blocks, the prevalence of SI joint pain is estimated between 6 – 10 %. Sacroiliac joint pain can be managed by intraarticular injections or neurolysis of the sacroiliac joint under fluoroscopic or CT guidance with good results[16].

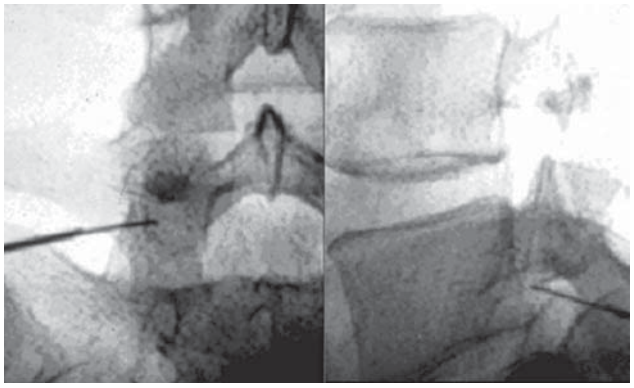

Fig 7: *Selective nerve root block with needle tip just below the pedicle.*

SI JOINT INJECTIONS

After confirming needle position, injection of 2 – 3 ml of solution of steroid and local anesthetic is carried out. With CT guidance in the patient prone position, the middle and inferior third of the joint are easily accessible with a dorsal, angulated approach (Fig 8). Evidence for intraarticular sacroiliac joint injections is moderate for short-term relief and limited for long-term relief. Apart from those complications inherent with all these interventions, a potential complication of trauma to the sciatic nerve is to be guarded against.

RADIOFREQUENCY NEUROTOMY OF SI JOINTS

Theoretically RF ablation of the SI joint should have a longer lasting effect than joint injections. Small retrospective studies have reported 50 – 60 % long-term pain relief (6-9 months) but these are small studies and no definite conclusions can be derived through them at this stage[17].

DRUGS, DOSAGE AND FREQUENCY OF INTERVENTIONS

There is little consensus with regards to type, dosage, frequency and total number of injections or other interventions. Most of the commonly used formulations of long-acting steroids including methylprednisolone (Depo Medrol®), triamcinolone diacetate (Aristocort®), triamcinolone acetonide (Kenalog®), and betamethasone acetate and phosphate mixture (Celestone Soluspan ®), appear to be safe and effective. Betamethasone may be the best choice in avoiding side effects if interventions are repeated within two weeks. However; if interventions are carried out at six-week intervals or longer, any one of the

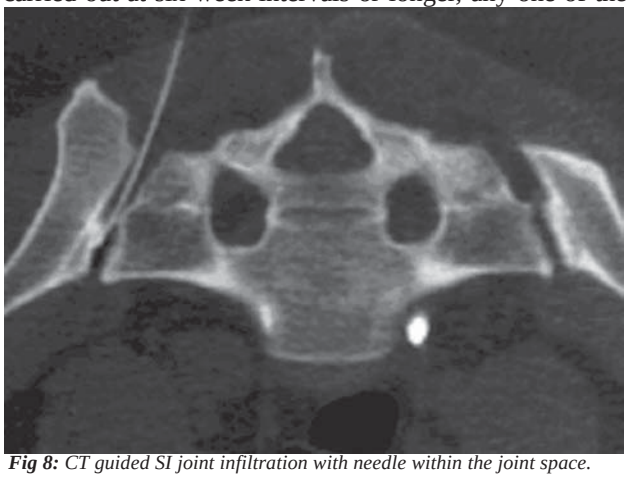

Fig 8: *CT guided SI joint infiltration with needle within the joint space.*

four formulations will be safe and effective[11].

CONCLUSION

Chronic back pain is a leading cause of morbidity in society. With better understanding of the anatomy and pathophysiology of back pain, it is now possible to deliver concentrated, guided boluses of therapeutic agents and neuro ablative procedures while minimizing systemic side effects. Most of these procedures can be performed in an out patient setting. Early interventions can minimize development of neuropathic pain and its chronicity. Many of these interventional procedures are not curative and should not modalities to be used in isolation but form a valuable component in the armamentarium of a pain clinic along with pharmacotherapy, physiotherapy, psychotherapy and rehabilitation.

Based on responses to controlled diagnostic blocks of these joints, facet joints have been implicated as responsible for spinal pain in as many as 15 % to 45 % of patients with low back pain[5] . Ghormley described facet joint mediated pain as early as in 1933 and also described the facet syndrome [7]. Since facet joint mediated pain is one of the commonest etiologies of chronic LBA, many techniques have been developed to diagnose and treat it. Described below are the most commonly practiced of these-namely, facet joint injections, facet denervations and injections for spondylolysis.

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